Rebuilding Green

Why Rebuild Green?
Using green building techniques to rebuild your home will reduce its impact on the environment and may lower your monthly utility costs. It will also result in a healthier and more comfortable living environment.

Green building, sometimes called sustainable building, is a whole-building approach to design and construction incorporating methods that save or reduce resources in five categories: site, water, energy, materials, and indoor environmental quality.

The following list presents some of the easiest and least costly approaches, which may offer long-term money savings. This list does not include all common green building features, but here is a start.

Site
Depending on the degree of your rebuild and your site, some of these approaches may not be applicable.

- ❑ **Orientation**: Orient the house on an east-west axis to reduce solar heat gain in summer and to take advantage of passive solar heating in winter.
- ❑ **Footprint**: Consider building multi-story rather than single story to have more open space outdoors.

Water
Consider using strategies that reduce water consumption.

- ❑ **Fixtures:** Install low-flow fixtures that exceed code requirements.
- ❑ **Landscape**: Plan appropriate landscape to reduce water consumption, reduce biomass, and use drip irrigation when possible.

Energy
Implementing energy-saving strategies can provide the greatest cost savings by reducing your monthly utility bills.

- ❑ **Windows**: Install energy-efficient windows. These are generally double-paned and use "low-e" glazing.
- ❑ **Insulation**: Install recycled-content cellulose insulation with a higher "R" value than code requires. Use formaldehyde-free insulation.
- ❑ **HVAC**: Choose an HVAC system rated SEER 12 or higher.
- ❑ **Roofing**: Choose a light-colored fire-resistant roofing material. Consider a radiant barrier to reduce heat build-up through the roof, thus reducing cooling requirements.
- ❑ **Appliances**: Install appliances that are energy- and water-efficient and are certified under the Energy Star program.

Materials
Select products that reduce the demand for virgin raw materials and that have a reduced impact on the environment.

- ❑ **Construction Waste Management**: Recycle at least 50 percent of the waste from your project. Typically wood, cardboard, and concrete are the easiest to recycle.
- ❑ **Recycled-Content Materials**: Use recycled-content materials when possible, for example, some carpet, paint, and tile are made with recycled material.
- ❑ **Durable materials**: Choose materials that are designed to last. More durable materials require less replacement and can save money in the long run.
- ❑ **Lumber**: Use engineered trusses or finger-jointed lumber and molding, since these reduce the need for new clear lumber. Use certified wood, which comes from forests that are managed in an environmentally preferable manner.
- ❑ **Rapidly Renewable Materials**: As an alternative to hardwood flooring, consider cork and bamboo. These regenerate faster than their wood counterparts.

Sustainable Building

Indoor Environment
Avoid materials that give off undesirable chemicals. When selecting materials for your project, consider alternatives that do not emit hazardous or toxic chemicals such as volatile organic compounds (VOC) and have no added formaldehyde. Provide ventilation to assure a good supply of fresh air.

- **Medium Density Fiberboard** (MDF): Choose MDF products made with no added formaldehyde.
- **Paint**: Use paint that contains little or no VOCs.
- **Adhesives**: Use adhesives that are solvent-free (non-VOC emitting).

Hire Experience
Hire an architect and building contractor who has experience with building green. This will help assure a successful project.

More Information
To look deeper into green building and explore the possibilities, check out some of the resources that follow. For more detailed information, please contact the sustainable building program at the California Integrated Waste Management Board (CIWMB) at (916) 341-6497.

CIWMB Web Resources

Sustainable Building
For general as well as specific green building information and links to other resources: www.ciwmb.ca.gov /GreenBuilding/.

CalMAX
The California Materials Exchange (CalMAX) is an electronic listing of available and wanted materials that are typically considered waste. CalMAX is a great place to find a bargain. www.ciwmb.ca.gov /CalMax/

Recycled Content Product (RCP) Database
A searchable database for locating RCPs. www.ciwmb.ca.gov/RCP/

Waste Streams Profile: Jurisdictions
A searchable database to identify your recycling coordinator and other local contacts. www.ciwmb.ca.gov/Profiles /Juris/

Waste Management Disaster Plan
www.ciwmb.ca.gov/Disaster /DisasterPlan/

Other Resources

Alameda County Waste Management Authority
This Web site has links to Alameda County's Green Building Guidelines for both new construction and for remolding. These offer comprehensive and cost-effective green building methods and are available for download. www.stopwaste.org /fsbuild.html

City of Los Angeles
The city's sustainable building program has developed a very comprehensive set of green building guidelines for their Residential Rehabilitation Guidebook. www.lacity.org/ead /EADWeb-MWR/Sust /sustainable_building.htm

Energy Star
A joint project from the U.S. Environmental Protection Agency and the Department of Energy, this Web site has a searchable database for appliances and information on residential programs. www.energystar.gov/

Bamboo Flooring

Introduction

This fact sheet is provided as a tool to aid design professionals or other parties interested in sustainable building materials and to provide an analysis of bamboo flooring using applicable sustainable building criteria. This information can be used as a piece of a larger life-cycle analysis or simply to help in comparing bamboo to other flooring choices. This fact sheet is neither a full life-cycle analysis of bamboo flooring nor an endorsement of any product or manufacturer.

What Is Bamboo Flooring?

Bamboo is a member of the grass family that "matures in three years, regenerates without need for replanting, and requires minimal fertilization or pesticides." The bamboo is harvested, sliced into strips, boiled in water with a preservative, and pressed flat. It is then laminated vertically or in three horizontal layers, and kiln-dried. Floors manufactured using the horizontal orientation may be prone to cupping, but this problem is eliminated when the center layer is oriented perpendicular to the top and bottom layers.

Some manufacturers also offer an engineered floor that utilizes a thin bamboo layer laminated over a non-bamboo material. One manufacturer now offers tongue-and-groove flooring made from bamboo-oriented strand board (OSB). This product is made using the post-industrial waste bamboo from floor manufacturing.

Bamboo flooring products are manufactured in varying dimensional tongue-and-groove strip sizes and lengths. These products are available either pre-finished or unfinished, and they are usually offered as either natural or amber-colored. Costs range from $4 to $8 per square foot for higher quality products.

Where Can Bamboo Flooring Be Used?

Bamboo flooring can be used in most residential and commercial applications where carpet, wood, tile, or resilient flooring is used. Some applications may be inappropriate—a high moisture area, for example—so consumers should confirm with the supplier to make sure the application is appropriate.

Depending upon the product, installation may be glue-down or nail-down. In engineered products, bamboo may be floated, and it can be used with concrete or wood subfloors. Manufacturers report that bamboo floors are maintained in the same manner as wood floors and can be refinished.

Sustainable Building Criteria Used

Whether seeking parameters for life-cycle analysis or simply trying to make an environmentally informed decision about a building material, the criteria for analysis must be defined.

For bamboo flooring products, several criteria were evaluated to provide this basic tool for decision-making. These criteria are taken from the following sources: LEED rating systems of United States Green Building Council; *Building Materials: What Makes a Product Green, Environmental Building News*, and the California Integrated Waste Management Board's Green Building Materials Web site.

When evaluating bamboo flooring materials, the two sustainability criteria most applicable for analysis are materials and resource efficiency and indoor environmental quality (IEQ).

Materials and Resource Efficiency

Materials and resource efficiency criteria look at various impacts on the environment that result from the extraction or harvest, manufacture, transportation, and disposal of the material.

Rapidly Renewable
One of bamboo's greatest benefits is the rate at which it renews itself. The three-to-five-year harvest cycle makes bamboo a rapidly renewable material, which is generally defined as having a harvest rotation of 10 years or less. In contrast, most hardwood species used for flooring reach saleable size in 50 to 100 years.

Recycled Content Product
To be considered a recycled-content material, the product should contain a certain amount of either postconsumer or post-industrial waste material. This is generally presented as a percentage of the total weight. The LEED Rating System has used 20 percent postconsumer and 40 percent post-industrial as minimum requirements for a product to be considered recycled content.

Some bamboo flooring products may be laminated over a core material made from medium density fiberboard (MDF), which generally contains some post-industrial wood fiber. The OSB flooring product also contains post-industrial recycled bamboo. It may—depending on the content percentage—be potentially considered a recycled-content material.

Transportation Issues
Nearly all bamboo for flooring is grown and manufactured in the Pacific Rim, generally in China or Vietnam. Therefore, any life-cycle analysis of these products should take into account both energy consumption and air emissions resulting from the transportation requirements of bringing the flooring to market. Some green building rating systems or guidelines give preference to the use of materials that either originate or are manufactured locally, which is often defined as within a 500-mile radius from the project.

Durability
Durable materials require less frequent replacement, generate less waste, and may also realize lower long-term costs. According to manufacturers, bamboo flooring should last a lifetime (30 to 50 years). The one-time costs of installing bamboo flooring should be less than the costs for multiple installations of less durable flooring options. Therefore, over the long-term, the consumer should save money. Replacing the flooring generates waste, so reducing the rate of replacement also reduces waste generation.

Without a single standard measurement for durability, the only comparable data available at this time are the results from standard Janka-Ball Hardness tests (ASTM D1037). Bamboo flooring ranges "from slightly lower than red oak *(*1290 PSI*)* to significantly harder—1130 PSI to 1640 PSI," making it a relatively hard material.

Since most bamboo flooring can be refinished, it should have a longer life than less durable flooring options such as carpet and some resilient flooring. The following list is from the *Residential Rehabilitation Inspection Guide* of the U.S. Department of Housing and Urban Development. Based on information provided by manufacturers and trade associations, it shows the life expectancy of several common flooring components used in residential applications:

- ❑ Oak or pine: lifetime.
- ❑ Slate flagstone: lifetime.
- ❑ Vinyl (sheet or tile) 20–30 years.
- ❑ Terrazzo: lifetime.
- ❑ Carpeting: 11 years.
- ❑ Marble: lifetime.

Since bamboo has a relative hardness comparable to oak, a very hard, durable wood, and exhibits similar properties to other wood floors, it is assumed to have a life expectancy comparable to wood flooring.

Indoor Environmental Quality
According to the U.S. EPA, Americans spend nearly 90 percent of their time indoors. Therefore, evaluating how

products impact IEQ is necessary. These impacts may include emissions of volatile organic compounds (VOC) and/or formaldehyde. Several factors should be considered when looking at the indoor environmental quality impacts of a material. For example, these may include ventilation rates of the space applied, decay rates for volatile components, and the overall emissions from other components.

Volatile Organic Compounds
At this time, little data is available relative to the emissions of VOC from bamboo flooring material.

Formaldehyde
Some bamboo flooring products are manufactured using formaldehyde-based adhesives, and formaldehyde emissions vary from brand to brand. Some brands claim the use of formaldehyde-free glues and finishes. Some manufacturers reported formaldehyde emissions at various ranges, from 16 μg/m³ to 330 μg/m³. The California Office of Environmental Health Hazard Assessment has listed formaldehyde as a "chemical of special concern." The agency has published the reference exposure levels (REL) for toxicity for both Chronic (3 μg/m³) and Acute (94 μg/m³ for 1 hour) exposures.
If you are considering bamboo flooring, inquire about VOC and formaldehyde emissions from the specific manufacturer or distributor. VOC and formaldehyde emissions should also be considered when choosing adhesives for glue-down installations, in the surface finishing material, and in the choice of subfloor materials.

Other Issues
Life-cycle analysis often includes examining environmental justice issues. Since most bamboo for flooring originates in the Asian Pacific Rim, the question of fair labor practices is a legitimate concern in the production and manufacture. To date, these practices have not been well documented. As a result, local product distributors may not have much direct control or be willing to say much about this issue.

Resources
The following Web sites offer information about sustainable building and materials.

California Integrated Waste Management Board, Sustainable Building Program
www.ciwmb.ca.gov/GreenBuilding/

- *Environmental Building News*, monthly, limited online version and ordering info www.buildinggreen.com/menus/news.cfm
- *Green Spec*, available online at www.buildinggreen.com/bg/gsmenu/index.jsp

CIWMB Contact Information
For more information about bamboo flooring, sustainable building materials, or sustainable building in general, please contact Gregory Dick of the CIWMB at gdick@ciwmb.ca.gov or (916) 341-6497.

The Collaborative for High Performance Schools

The Collaborative for High Performance Schools (CHPS, often referred to as "chips") aims to increase the energy efficiency of schools in California by marketing information, services, and incentive programs directly at school districts and designers. The Collaborative's goal is to facilitate the design of high performance schools: environments that are not only energy efficient, but also healthy, comfortable, well lit and contain the amenities needed for a quality education.

"High-performance school" refers to the physical facility—the school building and its grounds. Creating one is not difficult, but it requires an integrated "whole building" approach to the design process. Key systems and technologies must be considered together—from the beginning of the design process—and optimized based on their combined impact on the comfort and productivity of students and teachers.

A high-performance school is:

- ***Healthy***. Good indoor air quality is essential. It requires minimizing pollutant sources and providing adequate ventilation and air filtration. The significant amount of time that students and teachers spend inside schools during their educational career, combined with children's increased susceptibility to indoor pollutants, underscores the importance of healthy indoor environmental quality.

- ***Thermally, Visually, and Acoustically Comfortable***. Thermal comfort means that teachers, students, and administrators should be neither hot nor cold as they teach, learn, and work. Visual comfort means that quality lighting makes visual tasks, such as reading and following classroom presentations, easier. The lighting for each room is "designed," not simply specified. Daylight and electric lights are integrated, and glare is minimized. Visual comfort also means providing a connection to the outdoors and visual stimulation through the use of windows at eye level to offer views. Acoustic comfort means teachers and students can hear one another easily. Noisy ventilation systems are eliminated, and the design minimizes the amount of disruptive outdoor and indoor noise affecting the classroom.

- ***Energy-Efficient***. Energy-efficient schools save money while conserving non-renewable energy resources and reducing atmospheric emissions of pollutants and greenhouse gases. Heating, ventilating, and air-conditioning (HVAC) systems use high-efficiency equipment, are "right-sized" for the estimated demands of the facility, and include controls that optimize system performance. The school's lighting system uses high-efficiency products, optimizes the number of light fixtures in each room, incorporates control devices that ensure peak system performance; and successfully integrates electric lighting and daylighting strategies. The walls, floors, roofs, and windows of the school are as energy-efficient and cost-effective as possible. The building shell integrates and optimizes insulation levels, glazing, shading, thermal mass, air leakage, and light-colored exterior surfaces to minimize the use of the HVAC systems.

- ***Material Efficient***. To the maximum extent possible, the school incorporates building materials that have been produced in a way that conserves raw materials. Such materials may be manufactured with recycled content and rapidly renewable resources, they should be durable, and be able to be recycled or reused. In addi-

tion, the school has been designed and built in a manner that reduces waste and keeps reusable or recyclable materials out of the landfill.

- ***Water Efficient***. Water scarcity is a major problem in much of California. High-performance schools are designed to use water efficiently, saving money while reducing the depletion of aquifers and river systems and minimizing the use of sewage treatment systems. The school uses as little off-site water as possible to meet its needs, controls and reduces water runoff from its site, and consumes fresh water as efficiently as possible.

- ***Easy to Maintain and Operate***. Building systems are simple and easy to use and maintain. Teachers have control over the temperature, airflow, acoustics, and lighting in their classrooms, and they are trained on how to most effectively use them.

- ***Commissioned.*** The school operates the way it was designed and meets the district's needs. This happens through a formal commissioning process—a form of "systems check" for the facility. The process includes testing, verification, and fine-tuning the performance of key building systems so that they perform at the highest levels of efficiency and comfort. Finally, the staff receives training to properly operate and maintain the systems.

- ***An Environmentally Responsive Site.*** The site is recognized as an essential element of the school building's high-performance features. To the extent possible, the school's site conserves existing natural areas and restores damaged ones; minimizes stormwater runoff and controls erosion; and incorporates products and techniques that do not introduce pollutants or degradation to the project site or at the site of extraction, harvest, or production.

- ***A Teaching Tool***. By incorporating important concepts such as energy, water, and material efficiency, schools can become tools to illustrate a wide spectrum of scientific, mathematical, and social issues. HVAC and lighting equipment and controls systems can be used to illustrate lessons on energy use and conservation, and daylighting systems can help students understand the daily and yearly movements of the sun.

- ***Safe and Secure***. High performance does not compromise safety. Students and teachers feel safe anywhere in the building or on the grounds. Design primarily creates a secure environment, optimizing opportunities for natural surveillance, reinforcing a sense of community, and controlling access. Security technology enhances, rather than substitutes for, the design features.

- ***A Community Resource***. The most successful schools have a high level of parent and community involvement. This involvement can be enhanced if schools are designed for neighborhood meetings and other community functions.

- ***Stimulating Architecture***. High-performance schools should invoke a sense of pride and be considered a genuine asset for the community.

Visit www.chps.net for further details on upcoming CHPS Training sessions and to order your free school planning kit.

Putting It All Together

The knowledge and technical resources to build high-performance schools already exist. Your district can build sustainable schools if you demand them. You will need to plan early, know what to ask for, and verify that the design firms you hire have the required knowledge and skills.

Whether your district is building a new school or renovating an existing structure, keep in mind the following five key elements to creating a high-performance school.

- **Set Goals.** Develop your high-performance goals early. The benefits of high performance schools are achievable only when districts establish their goals from the beginning and fight for them over the course of the development process. The CHPS eligibility criteria provides a flexible way to set goals. This point system covers the essential elements of high-performance design and can be used by districts to clearly identify their priorities.

A focus on student and teacher performance—coupled with a concern for the environment and a commitment to cost-effectiveness—will help ensure that the effort is successful and that any school—no matter what its budget—achieves the highest performance level possible for its particular circumstances.

- **Communicate Goals to Designers.** Include these goals in the educational specifications and designer request for proposals to communicate early your design intentions. Choose a design team with the skills to make your goals a reality.

- **Pursue Integrated Design.** Insist on the development of an integrated design team to take full benefit of design options that affect the entire building performance.

- **Monitor Construction.** Communicate goals to the contractors, and be wary of substitutions or design changes during construction that might occur without consulting the designer.

- **Verify Goals.** Commission the building to prove that you are getting what you paid for, and that the building has been built as designed, and designed to your specifications.

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